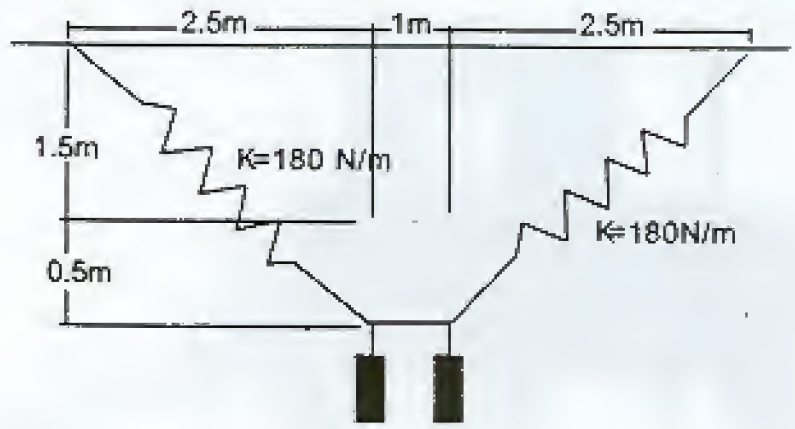
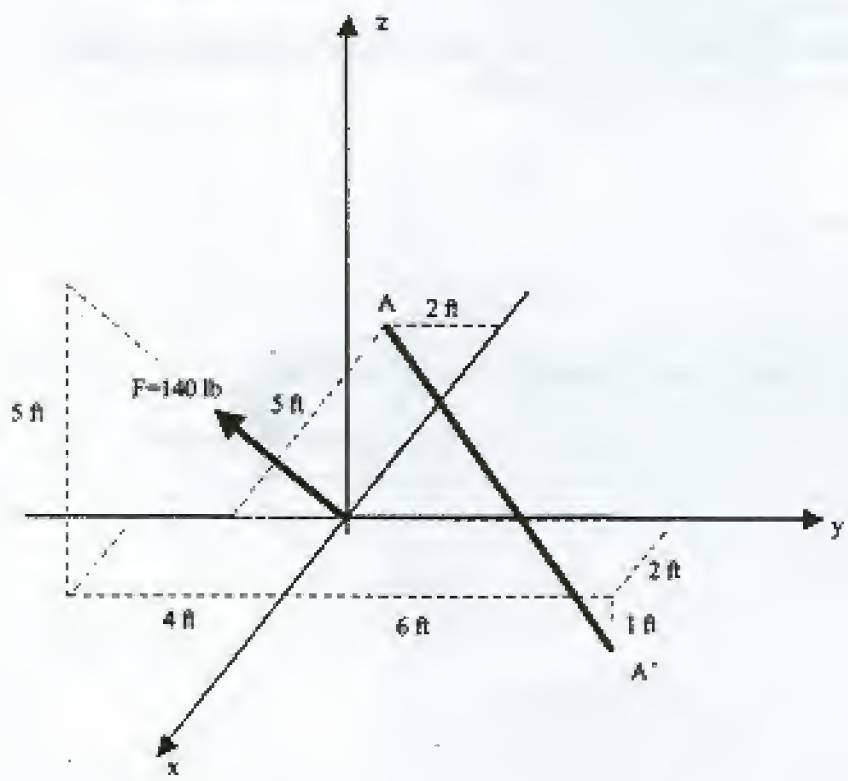
Dec. 2000

1) Two springs (k=180 N/m) are connected and assume the shape shown in light grey below. Two cylinders are then connected to the springs and the springs are deflected into the shape shown in black. Determine the mass (in kg) of each of the cylinders given the information below. Assume the cylinders are of equal mass.

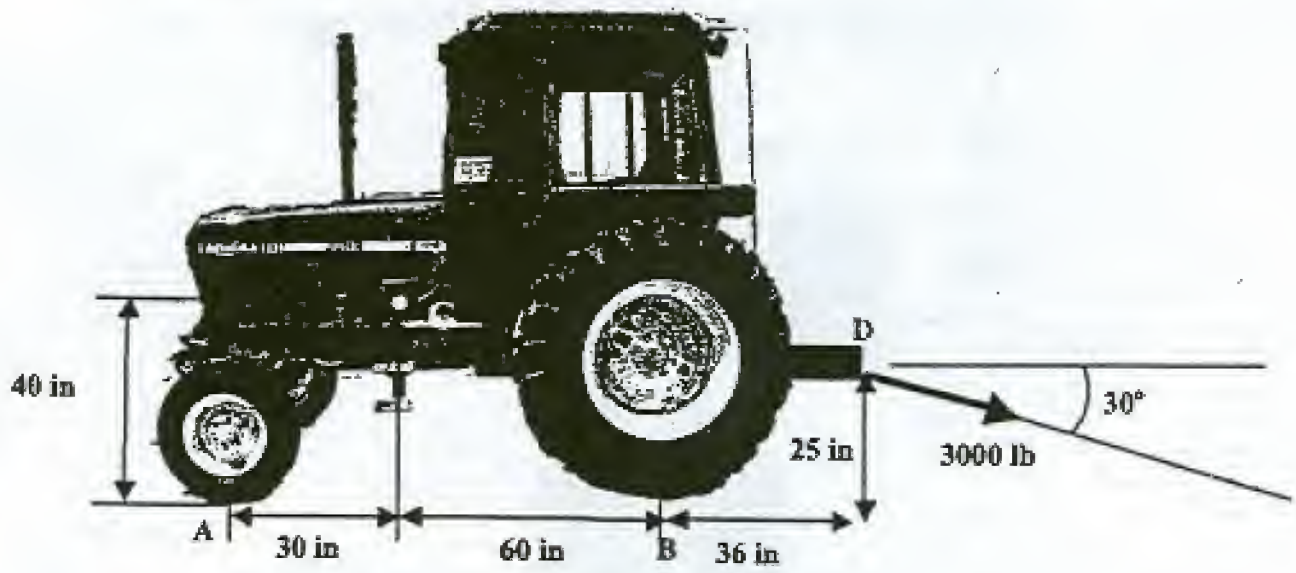


2) Calculate the moment vector $M_{AA'}$ generated by the 140 lb force about the axis AA'. Use Cartesian vectors.

F= 41.74i -85.48j +104.55k.



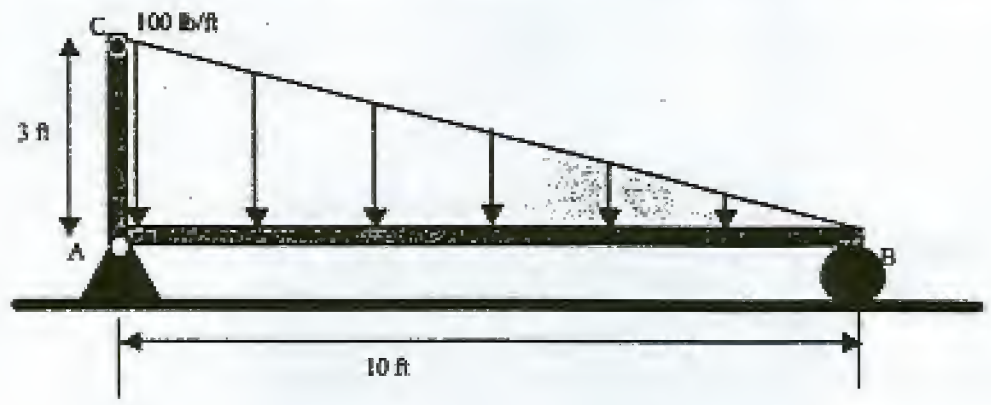
3) A tractor experiences a draw-bar pull of 3000 lb acting at D as shown. The tractor weighs 10,000 lb concentrated at the center of gravity G. Calculate the total reaction on the front pair of wheels and on the back pair of wheels in order to pull the load. The front wheels, A, are free to roll while frictional forces are being developed at the back wheels, B. (picture from www.motorcities.com)



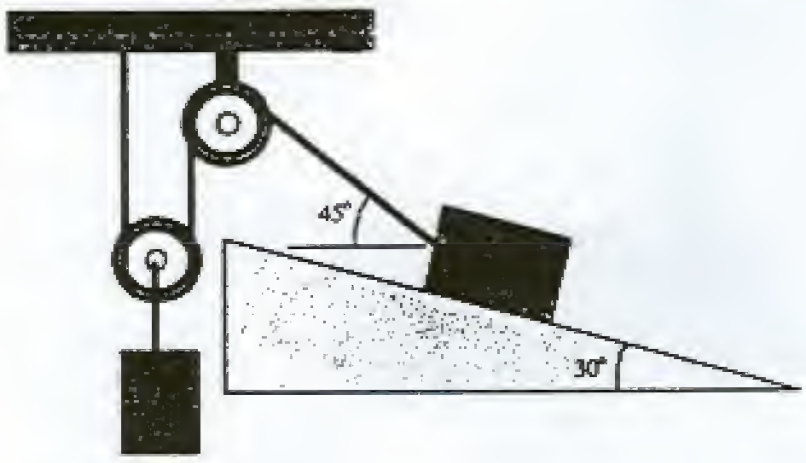
4) The beam shown below is supported on a roller and pin. The beam is subjected to a distributed load that only acts down and increases linearly from zero at B to w = 100 lb/ft at end A. Find:

a) The equilibrium forces acting at A and B.

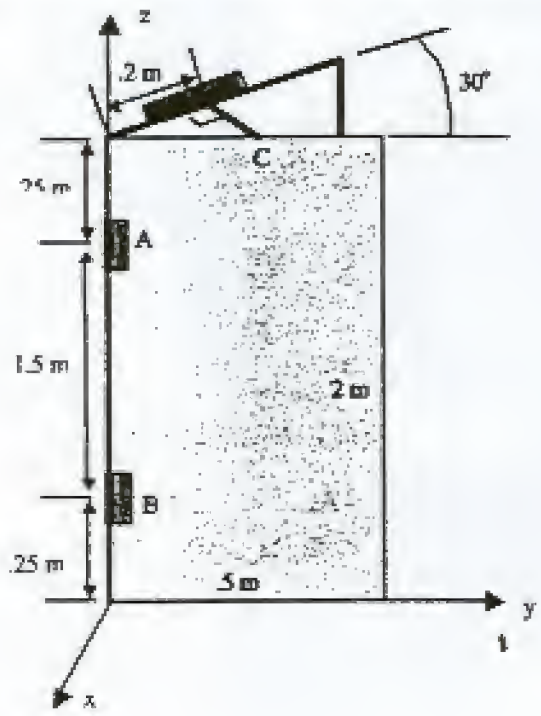
b) In place of the variable load, the equivalent force and moment to be applied at point C, that would produce the same reactions at A and B.



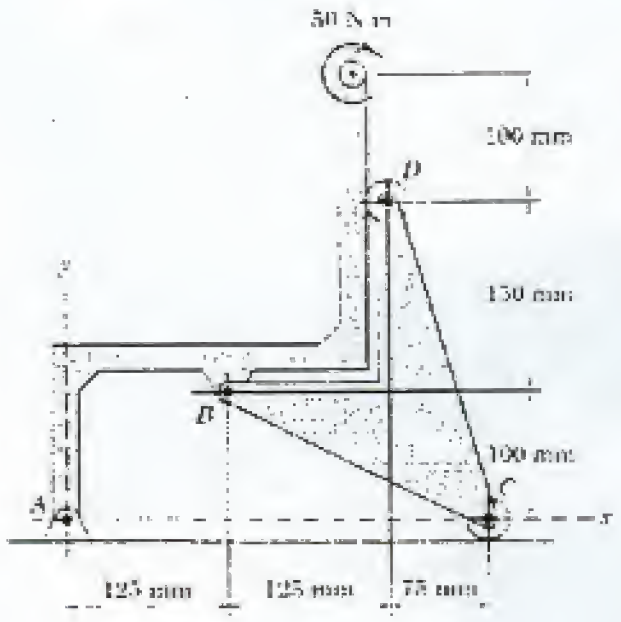
5) The hanging block has a weight of 200 N. The block on the slope has a mass of 100 kg. Determine the **magnitude and direction** of the friction force acting on the base of the block on the slope. ($\mu_s = 0.4$, $\mu_k = 0.2$) The pulleys are frictionless, one rope is used, and the incline is held stationary.



6) A door with an automatic door closer is swung open at a 30° angle such that the arm of the closer forms a right angle with the door frame. The door closer acts as a 2-force member. There is a moment reaction in each hinge of 10 Nm, acting around the axis of the hinge, that resists the closing of the door. Calculate the total force reaction acting at hinge A, hinge B and the door closer. Hinge B has a vertical (z) force reaction, while hinge A does not have a vertical reaction. The door is uniform and has a weight of 10 N.



7) Neglect the weights of the members and compute the x- and y-components of all forces on each of the two members of the machine resulting from the application of the 50-Nm couple.



8) Using the method of sections, calculate the forces in members DI, DE, and EI for the loaded truss shown. The horizontal and vertical force members are 3.00 metres long as shown in the diagram.